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# **Anchor River Chinook Salmon Stock Status Update, 2004**

by

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October 2004

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Alaska Department of Fish and Game

Divisions of Sport Fish and Commercial Fisheries



## Symbols and Abbreviations

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Weights and measures (metric)		General		Measures (fisheries)	
centimeter	cm	Alaska Administrative		fork length	FL
deciliter	dL	Code	AAC	mideye-to-fork	MEF
gram	g	all commonly accepted		mideye-to-tail-fork	METF
hectare	ha	abbreviations	e.g., Mr., Mrs., AM, PM, etc.	standard length	SL
kilogram	kg			total length	TL
kilometer	km	all commonly accepted			
liter	L	professional titles	e.g., Dr., Ph.D., R.N., etc.	<b>Mathematics, statistics</b>	
meter	m	at	@	<i>all standard mathematical</i>	
milliliter	mL	compass directions:		<i>signs, symbols and</i>	
millimeter	mm	east	E	<i>abbreviations</i>	
		north	N	alternate hypothesis	H <sub>A</sub>
<b>Weights and measures (English)</b>		south	S	base of natural logarithm	<i>e</i>
cubic feet per second	ft <sup>3</sup> /s	west	W	catch per unit effort	CPUE
foot	ft	copyright	©	coefficient of variation	CV
gallon	gal	corporate suffixes:		common test statistics	(F, t, $\chi^2$ , etc.)
inch	in	Company	Co.	confidence interval	CI
mile	mi	Corporation	Corp.	correlation coefficient	
nautical mile	nmi	Incorporated	Inc.	(multiple)	R
ounce	oz	Limited	Ltd.	correlation coefficient	
pound	lb	District of Columbia	D.C.	(simple)	r
quart	qt	et alii (and others)	et al.	covariance	cov
yard	yd	et cetera (and so forth)	etc.	degree (angular)	°
		exempli gratia	e.g.	degrees of freedom	df
<b>Time and temperature</b>		(for example)		expected value	<i>E</i>
day	d	Federal Information	FIC	greater than	>
degrees Celsius	°C	Code		greater than or equal to	≥
degrees Fahrenheit	°F	id est (that is)	i.e.	harvest per unit effort	HPUE
degrees kelvin	K	latitude or longitude	lat. or long.	less than	<
hour	h	monetary symbols		less than or equal to	≤
minute	min	(U.S.)	\$, ¢	logarithm (natural)	ln
second	s	months (tables and		logarithm (base 10)	log
		figures): first three		logarithm (specify base)	log <sub>2</sub> , etc.
<b>Physics and chemistry</b>		letters	Jan,...,Dec	minute (angular)	'
all atomic symbols		registered trademark	®	not significant	NS
alternating current	AC	trademark	™	null hypothesis	H <sub>0</sub>
ampere	A	United States		percent	%
calorie	cal	(adjective)	U.S.	probability	P
direct current	DC	United States of		probability of a type I error	
hertz	Hz	America (noun)	USA	(rejection of the null	
horsepower	hp	U.S.C.	United States	hypothesis when true)	α
hydrogen ion activity	pH		Code	probability of a type II error	
(negative log of)		U.S. state	use two-letter	(acceptance of the null	
parts per million	ppm		abbreviations	hypothesis when false)	β
parts per thousand	ppt, ‰		(e.g., AK, WA)	second (angular)	"
volts	V			standard deviation	SD
watts	W			standard error	SE
				variance	
				population	Var
				sample	var

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by

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## ABSTRACT

In response to guidelines established in the Sustainable Salmon Fisheries Policy (5 AAC 39.222), the Alaska Board of Fisheries (BOF) classified Anchor River Chinook salmon *Oncorhynchus tshawytscha* as a stock of management concern in November 2001. This report provides an update of Anchor River Chinook salmon stock status, research, and salmon habitat assessment projects undertaken to document fish population characteristics and assess watershed attributes.

Since 2001, the Division of Sport Fish of the Alaska Department of Fish and Game has continued to conduct aerial surveys to index Chinook salmon escapement in the Anchor River and initiated a new project using a Dual Frequency Identification Sonar (DIDSON) and weir to estimate escapement. Since 2001, only the 2004 aerial survey index count was within the sustainable escapement goal (SEG) range, however, based on sonar and weir counts, the estimate of Anchor River Chinook salmon escapement was a minimum of 8,678 in 2003, and approximately 11,885 in 2004. Because this more accurate assessment indicates that escapements are much greater and exploitation much lower than originally thought, the department recommends that Anchor River Chinook salmon no longer be designated as a stock of concern. The department has also identified impacts to fish habitat, purchased critical habitat to mitigate habitat loss, protected the watershed, and maintained angler access to the Anchor River.

Key words: Anchor River, Chinook salmon, *Oncorhynchus tshawytscha*, stock status, weir, sonar, DIDSON, habitat, off-road vehicle, timber sales.

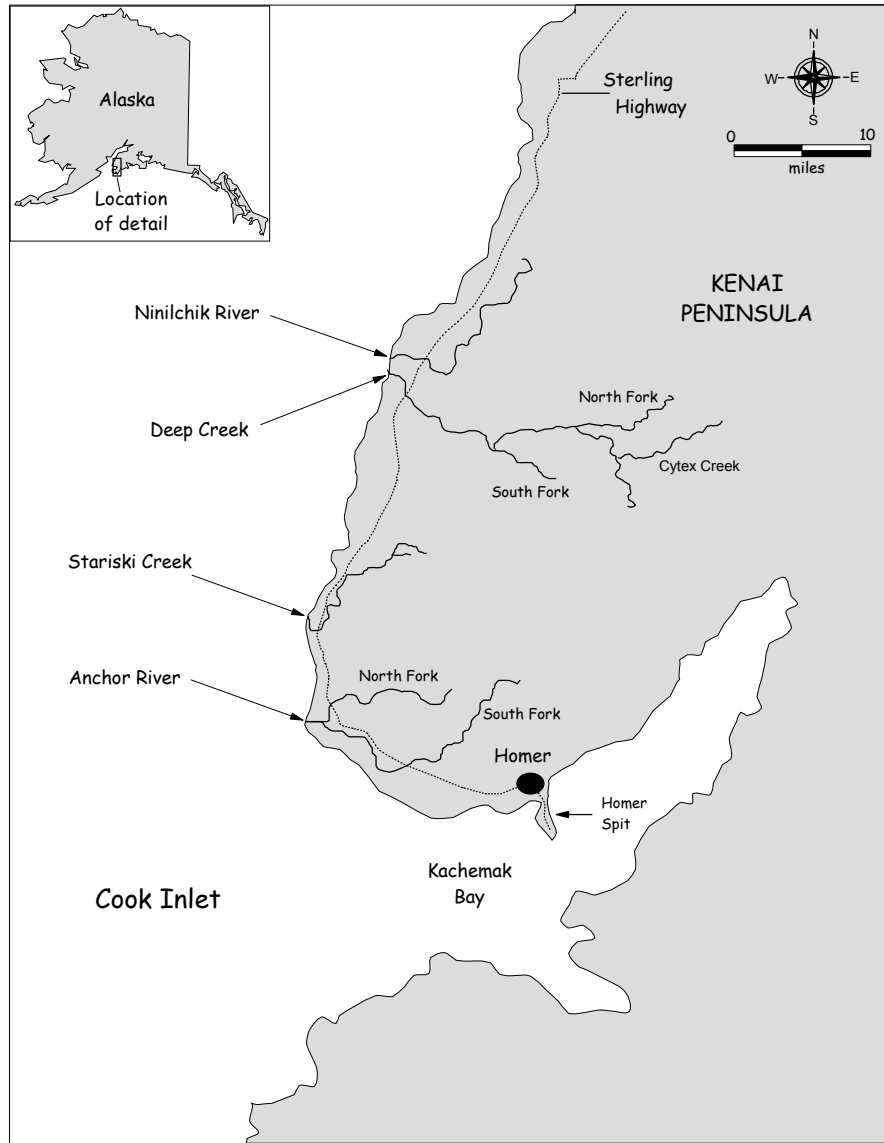
## INTRODUCTION

In the early 1970s, the major Chinook salmon sport fisheries in Southcentral Alaska were on the Anchor River, Deep Creek and Ninilchik River (Figure 1). Angler effort on the Anchor River peaked during the 1970s and then declined (Table 1). The reduced effort was attributed to the development of the Kenai River and Northern Cook Inlet freshwater Chinook salmon fisheries as well as the Cook Inlet marine sport fishery. From 1978 through 1988, Anchor River was open to fishing from its mouth upstream approximately 2 miles, during Memorial Day weekend and the next consecutive 3 weekends (four weekends in total).

The Alaska Board of Fisheries (BOF) liberalized fishing on the Anchor River in 1989 by adding a fifth consecutive 3-day weekend because of a declining trend in fishing effort during the late 1980s (Table 1). The Chinook salmon sport harvest on the Anchor River increased substantially following the extension of the fishing season; these large harvests continued through 1993 (Figure 2). Concurrent with the increased harvest was a decline in aerial survey index counts of Chinook salmon (Figure 3). In 1993, a Biological Escapement Goal (BEG) of 1,790 Chinook salmon for the Anchor River was adopted. The BEG was based on an average of annual counts from aerial and ground index surveys that were conducted in 1966 to 1969 and 1972 to 1991.

In 1996, the BOF adopted several regulations designed to decrease Chinook salmon harvest on the Anchor River in the face of low escapements including: (1) reducing the combined Chinook salmon annual bag limit from five to two for Anchor River and Deep Creek, (2) anglers could not fish for the remainder of the day in either stream after harvesting a Chinook salmon from the Anchor River or Deep Creek, and (3) closure of the North and South forks of the Anchor River upstream to all sport fishing until August 1 to protect spawning Chinook salmon. However, the Anchor River regulatory fishery opening was unchanged and remained open to fishing for five weekend only fishing periods.

In addition to the freshwater restrictions implemented in 1996, the BOF created the Upper Cook Inlet Marine Early Run King Salmon Management Plan (5 AAC 58.055). The plan was intended



**Figure 1.**-Location of the Anchor River and other Lower Cook Inlet roadside tributaries.

to stabilize the growing Chinook salmon fishery on fully exploited mixed stocks in the nearshore marine waters from Ninilchik to Bluff Point (Table 1). It also sought to prevent overexploitation of stocks thought to be intercepted in the fishery which were experiencing below average returns including Deep Creek and the Anchor River as well as the Kenai River and some northern Cook Inlet tributaries.

The plan established a rectangular special harvest area from Bluff Point north to Ninilchik that extends 1 mile seaward from the beach. From April 1 through June 30, within this special harvest area, guides could not fish while guiding clients and an angler could not fish for any species of fish for the remainder of the day after harvesting a chinook salmon, but could fish outside the special harvest area. Within the special harvest area, three conservation zones were established and were closed to fishing for all species from April 1 through June 30. These zones extended 1 mile seaward and encompassed the area from the mouth of the Ninilchik River to 2 miles south of Deep Creek, 1 mile on either side of Stariski Creek and 2 miles on either side of



**Table 1.**-Effort (angler-days), Chinook salmon harvest, and escapement in the Anchor River, and Chinook salmon harvest in the early-run marine recreational fishery north of Bluff Point, 1976-2004.

Year	Inriver Effort <sup>a</sup>	Inriver Harvest	Total Marine Harvest North of Bluff Pt. <sup>b</sup>	Escapement		
				Aerial Index	Sonar / Weir	Goal
1976		830	5,495	2,125		
1977	31,515	1,077	4,617	3,585		
1978	42,671	2,109	2,669	2,209		
1979	44,220	1,913	3,088	1,335		
1980	33,272	605	521	<sup>d</sup>		
1981	34,257	1,069	2,363	1,066 <sup>d</sup>		
1982	24,709	718	2,497	1,493		
1983	28,881	1,269	1,000	1,033		
1984	26,919	998	2,386	1,087		
1985	31,715	672	5,087	1,328		
1986	34,938	1,098	2,888	2,287		
1987	39,045	761	3,613	2,524		
1988	24,356	976	4,243	1,458		
1989	19,145	578	3,863	940		
1990	28,829	1,479	4,694	967		
1991	22,187	1,047	4,824	589		
1992	24,028	1,685	5,996	99		
1993	29,338	2,787	8,136	1,110		1,790
1994	27,856	2,478	6,850	837		1,790
1995	25,888	1,475	8,230	<sup>d</sup>		1,790
1996	16,016	1,483	4,702	277		1,790
1997	17,020	1,563	5,646	477		1,790
1998	14,310	783	5,783	789		1,050-2,200
1999	21,184	1,409	4,907	685		1,050-2,200
2000	22,971	1,730	4,773	752		750-1500
2001	19,195	889	3,671	414		750-1500
2002	19,245	1,047	3,368	748		750-1500
2003	17,482	1,011	4,042	680	8,678 <sup>e</sup>	750-1500
2004	----- not available -----			835	11,185 <sup>f</sup>	750-1500
1976-1988 Avg.	33,042	1,084	3,113	1,794		
1989+ Avg.	21,646	1,430	5,299	680		

Sources: 1976 harvest estimates from punch card returns and creel surveys (Hammarstrom 1977). 1977-2003 harvest and effort from the Statewide Harvest Survey (Mills 1979-1980, 1981a-b, 1982-1994; Howe et al. 1995, 1996, 2001 a-d; Walker et al. 2003; Jennings et al. 2004, *in prep.* a, b).

<sup>a</sup> Effort is the number of recreational angler-days expended on the Anchor River for all species.

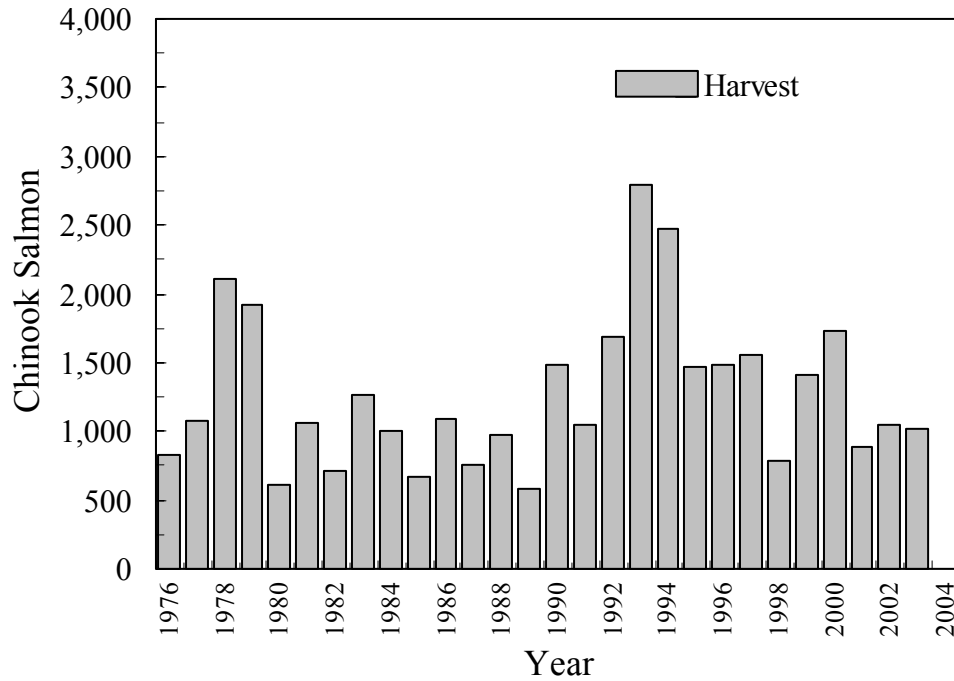
<sup>b</sup> Early-run harvest of all Chinook salmon in salt water north of Bluff Point prior to June 25. Harvest of Anchor River Chinook salmon in the marine fishery is probably very low (<200 fish; McKinley 1999; Begich *In prep.*).

<sup>c</sup> Index = Index Counts; BEG = Biological Escapement Goal, based on combined aerial and ground indices (ground indices not included in this table); SEG = Sustainable Escapement Goal, based on aerial indices alone.

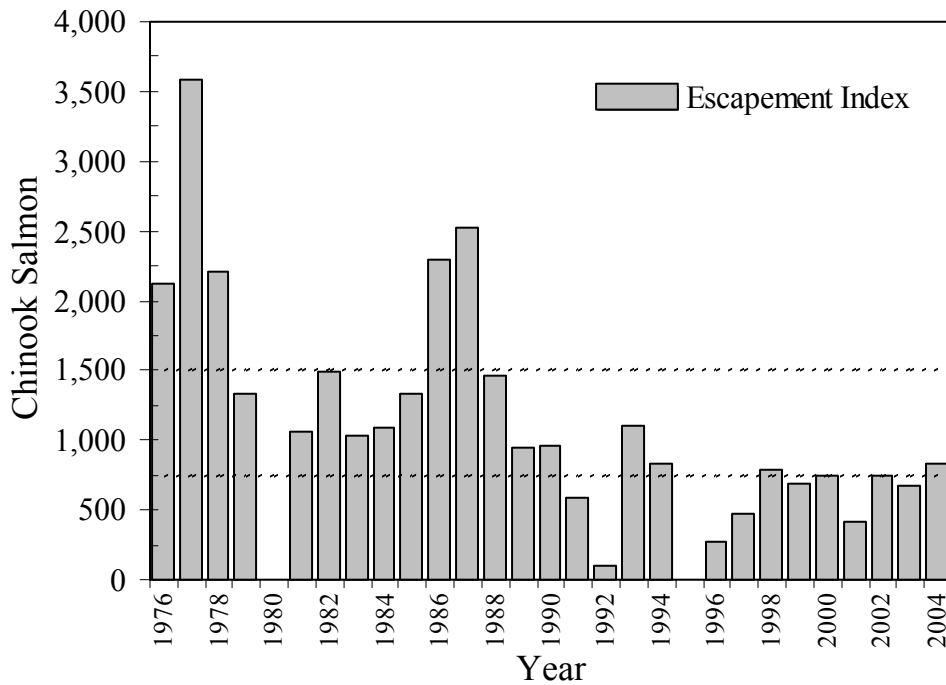
<sup>d</sup> Escapement counts not conducted or considered minimal due to high and/or turbid water during aerial escapement surveys.

<sup>e</sup> Preliminary estimate based on sonar counts and partial weir operation from May 15 through July 9.

<sup>f</sup> Preliminary estimate based on sonar counts and partial weir operation (May 15-June 9) and a complete resistance board floating weir (June 10-September 13).



**Figure 2.**—Freshwater harvest of Chinook salmon in the Anchor River, 1976-2004.



**Figure 3.**—Escapement index of Chinook salmon in the Anchor River (bars) relative to the current SEG range of 750-1,500 fish (dotted lines), 1976-2004.

the mouth of the Anchor River. The fishery north of Bluff Point was restricted by a harvest guideline of 8,000 Chinook salmon from April 1 to June 30. If this guideline was exceeded the plan called for an unspecified restriction of the fishery prior to the following season to ensure compliance with the guideline harvest level. The harvest reported in the Statewide Harvest Survey (SWHS) was the fishery performance measure. The plan remains in effect today.

In 1998, the Anchor River BEG was modified based on historical aerial survey index counts and their relationship to sport fishing harvests, which resulted in a BEG range of 1,050 to 2,200 Chinook salmon. In 2001, escapement goals were reevaluated for Cook Inlet salmon stocks in accordance with the Sustainable Salmon Fisheries (SSFP; 5 AAC 39.222) and the Policy For Statewide Salmon Escapement Goals (5 AAC 39.223). Since the total return of Anchor River Chinook salmon was unknown, the Escapement Goal Review Team evaluated this stock using a standard set of criteria from salmon stocks where total returns were known. Based on this analysis, the 25<sup>th</sup> to 75<sup>th</sup> percentiles of annual helicopter escapement surveys for the Anchor River were used to set a sustainable escapement goal (SEG) between 750-1,500 Chinook salmon for the Anchor River.

During the BOF meeting in November of 2001, the BOF designated Anchor River Chinook salmon as a stock of “management concern”. The “management concern” designation was the result of escapement indexes below the SEG range in 8 of the 13 years surveyed from 1989-2001. Furthermore despite the BOF actions in 1995-1996 to correct these downward trends, escapement indexes were below the SEG range in 1996, 1997, 1999, and 2001 and near the lower SEG range in 1998 and 2000. As a result, the BOF reduced the regulatory fishery openings for Chinook salmon from five to four 3-day weekends.

In 2003, the department initiated a DIDSON project to assess Chinook salmon escapement and production. Based on sonar counts (between 30 May to 9 July) the escapement was a minimum of 8,678 Chinook salmon. In 2004, Chinook salmon escapement was estimated using the sonar until river levels lowered, at which time a complete resistance board-floating weir was installed to continue escapement monitoring through September 13. Based on sonar and weir counts, the 2004 Chinook salmon escapement was approximately 11,885 fish.

Sonar and weir counts of Chinook salmon escapement are considerably higher than aerial indices, and better represent true run size. In light of this new information, indicating exploitation of Anchor River Chinook salmon is much lower than originally thought, the department recommends that Anchor River Chinook salmon no longer be designated a stock of management concern.

## **RESEARCH**

### **ESCAPEMENT MONITORING**

The department has indexed Chinook salmon escapement on the Anchor River since 1962 using a combination of ground and aerial surveys. Starting in 1976, only helicopter surveys were used to index Chinook salmon escapement. In 2003, the department initiated a DIDSON and weir project in the mainstem of the Anchor River to more accurately assess the long-term fluctuations in Chinook salmon escapement. In conjunction with escapement monitoring, biological sampling was conducted to estimate age and sex composition of the Chinook salmon return. In 2004, the department expanded the assessment project to estimate coho salmon *O. kisutch*

escapement and opportunistically monitor rainbow/steelhead trout *O. mykiss*, Dolly Varden *Salvelinus malma*, and pink salmon *O. gorbusca* escapement.

### **Aerial Survey Escapement Index**

In 2001, escapement goals were reevaluated for Cook Inlet salmon stocks in accordance with the Policy For Statewide Salmon Escapement Goals. Since the total return of Anchor River Chinook salmon was unknown, an SEG range of 750 to 1,500 Chinook salmon was recommended based on annual helicopter escapement survey data (Bue and Hasbrouck 2001).

Escapement index counts, since the stock of management concern designation in 2001, were below the SEG range in 2002 (748 fish) and 2003 (640 fish). In 2004, the escapement index was 834 fish, which marked the highest index since 1994.

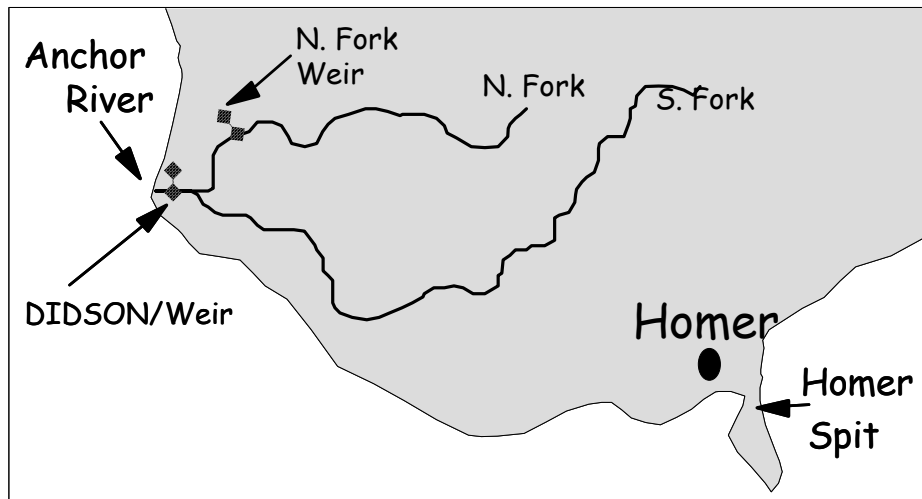
### **DIDSON and Weir Escapement Estimates**

A DIDSON and partial weir were operated on the Anchor River in 2003 and 2004. Also in 2004, a total weir was used to extend the monitoring period. The sonar/weir site was located upstream of the fishery and just downstream in the mainstem near the confluence of the North and South forks, approximately 2-miles upstream from the mouth (Figure 4).

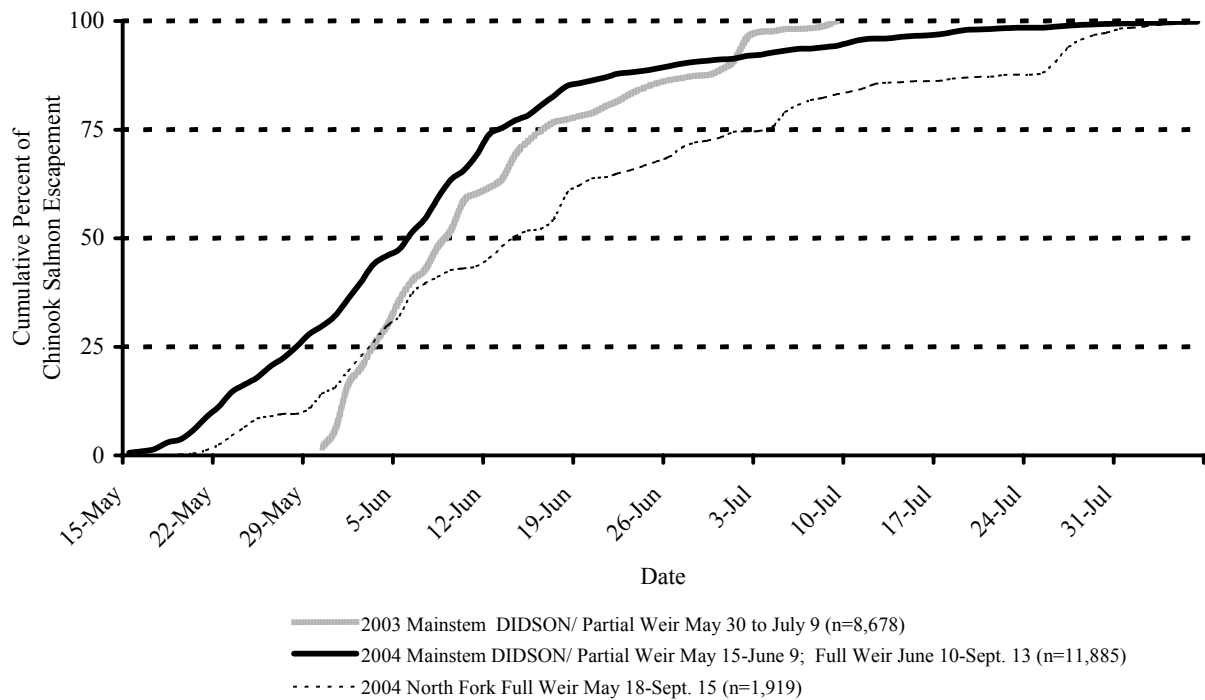
In 2003, the escapement estimate from May 30 to July 9 was 8,678 Chinook salmon. The sonar count represents a minimum estimate for several reasons: (1) counting was initiated well into the migration; (2) species identification isn't yet reliable with DIDSON technology and the estimate represents the net upstream count after downstream migrating fish including rainbow/steelhead trout are subtracted; and (3) fish smaller than the largest sized Dolly Varden captured during upstream beach seining were removed from the counts, which overlapped the smallest sized 2-ocean Chinook salmon captured. Fifty percent of the estimated escapement passed the mainstem sonar/weir by June 9 (Figure 5).

Age, sex, and length (ASL) estimates of the 2003 Chinook salmon escapement were determined from beach seine samples collected above the sonar/weir site on the North and South forks of the Anchor River. Because the contribution from the forks to escapement was unknown, ASL data were weighted by data collected in 2004 where contribution was known. Based on the preliminary results the Chinook salmon spawning population was composed of approximately 59% males and 41% females, and ocean age-3 was the dominant age class (58%).

In 2004, the escapement estimate from May 9 to September 13 was approximately 11,885 Chinook salmon. The estimate was based on combined counts from the sonar and partial weir from May 15 to June 9, and a resistance board-floating weir that completely spanned the river from June 9 until September 13. The Chinook salmon count represents the minimum escapement because downstream migrating fish including steelhead were subtracted from the sonar count. Fifty percent of the escapement passed the mainstem sonar by June 6 (Figure 5). In addition to the mainstem sonar/weir, the department operated a resistance board weir on the North Fork Anchor River (Figure 4) from May 18 to September 15, which was funded by the EVOS GEM (Exxon Valdez Oil Spill Gulf Ecosystem Monitoring) program. Included with escapement monitoring at the North Fork weir, samples of juvenile fish, invertebrates and streamside vegetation for analysis of marine-derived nutrients (MDN) were collected throughout the salmon migration period at stations located along the North Fork. The study will determine if adult salmon abundance can be indexed with marine derived carbon, nitrogen and sulfur transported by adult salmon and taken up by freshwater vegetation and vertebrate and



**Figure 4.**-Locations of the mainstem DIDSON and weir site, and North Fork weir site on the Anchor River.



**Figure 5.**-Cumulative percent of Chinook salmon estimated at the Anchor River mainstem DIDSON site in 2003 and 2004, and the North Fork weir in 2004.

invertebrate residents. The North Fork Chinook salmon weir count was approximately 16% (n = 1,919) of the mainstem count. Marine derived nutrient analysis results are pending.

Age and sex estimates of the 2004 Chinook salmon escapement were determined from samples collected from the following locations: the North Fork weir, the South Fork using a beach seine, and the mainstem DIDSON/weir site. Based on the preliminary results, the spawning population was composed of approximately 55% males and 45% females, and ocean age-3 was the dominant age class (49%).

### **Future Escapement Monitoring**

In subsequent years, the department will estimate and manage Anchor River Chinook and coho salmon escapements using sonar and weir counts from mid-May through mid-September. The North Fork weir is tentatively scheduled to monitor Chinook and coho salmon escapement during May through September of 2006. Furthermore, opportunistic counts of steelhead, pink salmon, and Dolly Varden will be collected throughout the operation of both projects. The department will continue to index Chinook salmon using aerial surveys. The department will attempt to correlate paired data from aerial survey indices and sonar/weir counts to determine the relationship of current escapement to historic escapement levels. The department will also evaluate the effects of the 2002 flood on salmon production in future years using sonar/weir escapement estimates.

### **MARINE HARVEST OF ANCHOR RIVER STOCKS**

A coded wire tag (CWT) recovery project was initiated in 1996 and was conducted through 2002 to obtain quantitative estimates of stock composition of the Cook Inlet marine Chinook salmon harvest (McKinley 1999). This project monitored the Central Cook Inlet marine sport harvest for Chinook salmon that were tagged as smolt from Cook Inlet hatchery releases including the Ninilchik River, and for wild Chinook salmon that were tagged as fingerlings or smolt in the Kenai River, Willow Creek, the Deshka River and Deep Creek. All the major age classes of chinook salmon returning to Deep Creek from 1998 through 2000 contained a fraction of fish with coded wire tags. The estimated marine harvest of Deep Creek-origin Chinook salmon in the early run ranged from only 77 to 281 fish (Szarzi and Begich 2004; Szarzi et al. *in prep.*). Hatchery-reared Chinook salmon stocked in the Ninilchik River are all marked. The estimated marine harvest of Ninilchik hatchery fish was less than 200 fish in all years. The contribution of the three other local wild stocks (Anchor River, Stariski Creek, and Ninilchik River wild) is likely low. Tag recovery data indicate that the origin of the harvest of fish returning to spawn in Cook Inlet is of a broad distribution composed of numerous individual stocks, none of which make up a large component. Annual sport harvests of Chinook salmon in the marine waters north of Bluff Point since 1996 have been well below the 8,000 fish harvest guideline (Table 1).

### **SPORT FISHERY IMPACTS**

Currently, the sport fishery is open in the Anchor River on four consecutive 3-day weekends, starting Memorial Day, downstream of the confluence of the North and South forks. On July 1, the area downstream of the forks is open to fishing for all species other than Chinook salmon 20 inches or greater in length. Beginning August 1, the entire river opens to fishing except only jack salmon may be taken above the North and South forks. Operation of sonar from May to approximately early June will require closure of 110 ft of the Anchor River upstream of the weir to the upper boundary of the fishery at the confluence of the North and South forks. A smaller area approximately 50 ft in length will be closed downstream of the weir. The total closed area

of the fishery during field operations will be approximately the upper 160 ft of the fishery. From early to middle June when the compete resistance board weir is installed, the sport fishery will be closed in waters approximately 300 ft upstream and 300 ft downstream of the weir as indicated by department markers to protect holding fish (5 AAC 75.050 (a) and (b)). The total closed area for operation of the full weir will be a distance of approximately 600 ft.

No further restriction of the marine fishery has occurred since 1996, nor is any anticipated at this time.

## **HABITAT MONITORING AND IMPROVEMENT**

Major habitat alterations in the Anchor River drainage occurred in fall of 2002 from two major floods. Furthermore, habitat concerns continue for the Anchor River drainage caused by increased use of recreational off-road vehicles (ORV), continued salvage logging, an extensive road and trail network, increased oil and gas exploration, development and transportation, gravel mining, and recreational and residential development.

### **Maintenance of Existing Levels of Public Lands with Fish Habitat**

Staff continue to review and comment on land use actions initiated by the ADNR for effects on fish habitat. These include conveyances of state lands to the Kenai Peninsula Borough and land use leases and permits issued to private individuals. Land classifications proposed by the Kenai Peninsula Borough are also reviewed.

### **Fish Passage Improvement Program**

In 2003, staff completed a culvert inventory and fish passage assessment project on all state-maintained roads throughout the Kenai Peninsula. During the 2004 field season, staff completed a fish passage inventory for private logging roads in the southern Kenai Peninsula. From these inventories, several culverts in the Anchor River watershed were classified as fish passage barriers. Staff has received funding to improve fish passage in the Kenai Peninsula and will be working closely with the Department of Transportation (DOT), Kenai Peninsula Borough, private landowners, and ADNR staff to improve conditions at these road-stream crossings. ADF&G also received funding to improve fish passage in Two Moose Creek and will replace a failing bridge with a new bottomless arch culvert in fall 2004. The South Fork of Two Moose Creek is an important tributary stream of the Anchor River that provides 10 miles of spawning and rearing habitat for Anchor River Chinook and coho salmon. In cooperation with local landowners and U.S. Fish & Wildlife Service, staff installed a new steel bridge to replace a log bridge that washed out in the 2002 floods, which eliminated the need for people to drive through the stream. Currently staff is working with local landowners and ADNR in Beaver Creek (an Anchor River tributary) by providing technical assistance to develop a stream-crossing project that will improve upstream passage for juvenile salmon. Staff has developed a prioritization protocol for identifying fish passage projects in the Kenai Peninsula, some of which may likely be located in the Anchor River watershed.

### **ORV Trail Planning**

ADF&G staff initiated a planning effort in 2001 to identify issues, concerns and potential solutions to the impacts of off-road vehicle (ORV) use on the lower Kenai Peninsula. The first step was to interview a broad spectrum of potential ORV stakeholders. Individuals interviewed in the scoping process included landowners and managers, resource specialists, ORV industry representatives, environmental groups, legislators, Board of Fisheries and Board of Game advisory committee members, sportsman's groups, snow machine clubs and other trail users such

as eco-tour operators and bicyclists. The interviews were a qualitative effort to (1) isolate the issues surrounding ORV use, (2) identify appropriate stakeholders to participate in a planning process, (3) evaluate the importance of developing an ORV plan, and (4) identify an appropriate planning process and any products which would help implement a plan.

The second step has been a collaborative effort among ADF&G and ADNR, Divisions of Parks and Outdoor Recreation and Mining, Land and Water. The project, funded through a Coastal Impact Assessment Project grant, has three objectives: (1) locate and map known trails; (2) determine the number and extent of stream and wetland crossings associated with each trail; and (3) assess the current condition of each trail and prioritize them, or portions of them, for repair, relocation or closure.

Public meetings were conducted in May 2004. Stakeholders identified and prioritized the various access concerns, and established preliminary estimates of trail usage. Through the public meeting process, four trails (Ninilchik Dome Trail, North Fork Trail, Watermelon Trail and the 126 Trail) were chosen for further assessment. Trails were selected based on public comment, legal access issues, and the need to focus our efforts given the vast network of trails found on the Kenai Peninsula.

During the summer of 2004, the four trails were mapped using a survey grade GPS receiver/data-logger. In addition to trail alignment, various trail characteristics (e.g. grade, tread width, soil type, erosion/rutting, drainage) were recorded. The trails inventory will highlight the physical characteristics along the entire alignment of the four trails, including the location of damaged areas. Data acquired will be evaluated during the coming year. Data from this study will be used as a foundation for planning a more in-depth study of environmental impacts at stream and wetland crossings and provide a basis for determining physical changes over time.

In the future, ADNR staff intends to utilize the GPS information to develop recommendations for managing or improving each trail. Each trail will be divided into logical segments with specific prescriptions. Because trail segments would be regarded as self-contained smaller projects, the stakeholder organizations could assume responsibility for these segments as individual work plans. Projects will be varied and range from the installation of a bridge over an anadromous stream, to boardwalks across a wetland or muskeg, to rerouting to higher ground, or realignment around private parcels. Because portions of these trails are located within the Anchor River watershed, this project should result in long-term benefits to Anchor River salmonids.

## **Land Purchases**

The department has been actively involved in habitat protection efforts on the Anchor River. Through the Exxon Valdez Trustee Council, the state successfully acquired a 20-acre parcel just downstream of the Sterling Highway (Elliot), and another 60-acre parcel just upstream (Thorne/Crowser). Three additional acquisitions (Knol-37 acres; Thompson-61 acres; Nakata-5 acres) are in the final stages of completion. All of these parcels will be managed by ADF&G. In cooperation with The Nature Conservancy, ADF&G also obtained and is administering a National Coastal Wetland Conservation Grant to purchase approximately 75 acres of estuarine wetlands and barrier beach near the mouth of the Anchor River. These and future purchases are expected to provide lasting benefits for Pacific salmon, steelhead trout and Dolly Varden that migrate, spawn and rear throughout the river. These efforts are also intended to ensure that angler access is maintained on the Anchor River.



## **STOCK OF MANAGEMENT CONCERN STATUS**

The stock of management concern status of Anchor River Chinook salmon was based on the best available data at the time. Since then escapement results in 2003 and 2004 from the sonar/weir project have indicated a much higher escapement level than has been indicated from 27 years of aerial survey data (Table 1). In 2004, the department based management decisions for the Anchor River Chinook salmon on sonar/weir counts. On June 21, 2004, the department issued an Emergency Order (2-KS-7-07-04) after approximately 7,000 Chinook salmon had passed the Anchor River sonar/weir site. The emergency order allowed 3 more days (12:00 a.m., Saturday, June 26, 2004 through 11:50 p.m. June 28, 2004) of fishing for Chinook salmon on the Anchor River.

The 2005 outlook for Anchor River Chinook salmon is expected to be similar to the 2003 return based on a five-year average (2000-2004) escapement index of 685 (Table 1). The effect of the 2002 Anchor River flood on Chinook salmon production has not been determined thus far. The annual harvest estimate for 2002 and 2003 was approximately 1,000 Chinook salmon each year. The instream exploitation of Chinook salmon was likely near this level and estimated at approximately 10 percent. During the most recent 5 years (1997–2001) when the Anchor River was open for five periods, the average annual instream harvest of Chinook salmon was 1,275 and did not exceed 2,000 Chinook salmon. From 1997 to 2001, the marine harvest did not exceed 6,000 Chinook salmon. Since code-wire-tagging data is unavailable to determine the harvest of Anchor River Chinook salmon in the mixed stock marine fisheries, coded wire tag results estimating a 3% mixed stock harvest for nearby Lower Cook Inlet streams are used to estimate 180 Anchor River Chinook salmon in the mixed stock marine sport harvest.

Projecting a liberal annual instream harvest of 2,000 and marine harvest of 180 Chinook salmon in 2003 and 2004, the resulting exploitation rate would have been approximately 24% and 18%, respectively. This is a sustainable level of exploitation for Chinook salmon and can be increased to some extent and still be sustainable. The Anchor River Chinook salmon assessment program is new, and the relationship of escapement levels estimated with sonar and weir to the historic escapement is unknown. If future escapements are maintained, a cautious incremental approach should be taken in changing the current regulatory structure.

The department recommends dropping the current SEG based on aerial surveys. We currently lack sufficient information to recommend a new goal range based on the sonar/weir project. However, available sonar/weir data will be used to evaluate escapements and exploitation to recommend an updated SEG goal range at the next Lower Cook Inlet BOF meeting in 2007. Subsequently, a biological escapement goal (BEG) will be estimated when sufficient stock-recruit data is available.

## REFERENCES CITED

- Begich, R. N. *In prep.* Contributions of coded wire tagged Chinook salmon to the early-run marine sport fishery in Central Cook Inlet, 1999 through 2001. Alaska Department of Fish and Game, Fishery Data Series, Anchorage.
- Bue, B. G., and J. J. Hasbrouck. 2001. Escapement goal review of salmon stocks of Upper Cook Inlet. Report to the Alaska Board of Fisheries, October 2001. Alaska Department of Fish and Game, Division of Sport Fish, Anchorage.
- Hammarstrom, S. L. 1977. Evaluation of chinook salmon fisheries of the Kenai Peninsula. Alaska Department of Fish and Game. Federal Aid in Fish Restoration, Annual Performance Report, 1976-1977, Project F-9-9, 18 (G-II-L), Juneau.
- Howe, A. L., G. Fidler, A. E. Bingham, and M. J. Mills. 1996. Harvest, catch, and participation in Alaska sport fisheries during 1995. Alaska Department of Fish and Game, Fishery Data Series No. 96-32, Anchorage. <http://www.sf.adfg.state.ak.us/FedAidPDFs/fds96-32.pdf>
- Howe, A. L., G. Fidler, and M. J. Mills. 1995. Harvest, catch, and participation in Alaska sport fisheries during 1994. Alaska Department of Fish and Game, Fishery Data Series No. 95-24, Anchorage. <http://www.sf.adfg.state.ak.us/FedAidPDFs/fds95-24.pdf>
- Howe, A. L., R. J. Walker, C. Olnes, K. Sundet, and A. E. Bingham. 2001a. Revised Edition. Harvest, catch, and participation in Alaska sport fisheries during 1996. Alaska Department of Fish and Game, Fishery Data Series No. 97-29 (revised), Anchorage. [http://www.sf.adfg.state.ak.us/FedAidPDFs/fds97-29\(revised\).pdf](http://www.sf.adfg.state.ak.us/FedAidPDFs/fds97-29(revised).pdf)
- Howe, A. L., R. J. Walker, C. Olnes, K. Sundet, and A. E. Bingham. 2001b. Revised Edition. Harvest, catch, and participation in Alaska sport fisheries during 1997. Alaska Department of Fish and Game, Fishery Data Series No. 98-25 (revised), Anchorage. [http://www.sf.adfg.state.ak.us/FedAidPDFs/fds98-25\(revised\).pdf](http://www.sf.adfg.state.ak.us/FedAidPDFs/fds98-25(revised).pdf)
- Howe, A. L., R. J. Walker, C. Olnes, K. Sundet, and A. E. Bingham. 2001c. Revised Edition. Participation, catch, and harvest in Alaska sport fisheries during 1998. Alaska Department of Fish and Game, Fishery Data Series No. 99-41 (revised), Anchorage. [http://www.sf.adfg.state.ak.us/FedAidPDFs/fds99-41\(revised\).pdf](http://www.sf.adfg.state.ak.us/FedAidPDFs/fds99-41(revised).pdf)
- Howe, A. L., R. J. Walker, C. Olnes, K. Sundet, and A. E. Bingham. 2001d. Participation, catch, and harvest in Alaska sport fisheries during 1999. Alaska Department of Fish and Game, Fishery Data Series No. 01-8, Anchorage. <http://www.sf.adfg.state.ak.us/FedAidPDFs/fds01-08.pdf>
- Jennings, G. B., K. Sundet, A. E. Bingham, and D. Sigurdsson. 2004. Participation, catch, and harvest in Alaska sport fisheries during 2001. Alaska Department of Fish and Game, Fishery Data Series No. 04-11, Anchorage. <http://www.sf.adfg.state.ak.us/FedAidPDFs/fds04-11.pdf>
- Jennings, G. B., K. Sundet, A. E. Bingham, and D. Sigurdsson. *In prep.-a.* Participation, catch, and harvest in Alaska sport fisheries during 2002. Alaska Department of Fish and Game, Fishery Data Series, Anchorage
- Jennings, G. B., K. Sundet, A. E. Bingham, and D. Sigurdsson. *In prep.-b.* Participation, catch, and harvest in Alaska sport fisheries during 2003. Alaska Department of Fish and Game, Fishery Data Series, Anchorage.
- McKinley, T. R. 1999. Contributions of coded wire tagged chinook salmon to the recreational fishery in Central Cook Inlet, Alaska, 1996. Alaska Department of Fish and Game, Fishery Data Series No. 99-2, Anchorage. <http://www.sf.adfg.state.ak.us/FedAidPDFs/fds99-02.pdf>
- Mills, M. J. 1979. Alaska statewide sport fish harvest studies. Alaska Department of Fish and Game, Federal Aid in Fish Restoration, Annual Performance Report 1978-1979, Project F-9-11, 20 (SW-I-A), Juneau. [http://www.sf.adfg.state.ak.us/FedAidPDFs/f-9-11\(20\)SW-I-A.pdf](http://www.sf.adfg.state.ak.us/FedAidPDFs/f-9-11(20)SW-I-A.pdf)
- Mills, M. J. 1980. Alaska statewide sport fish harvest studies. Alaska Department of Fish and Game. Federal Aid in Fish Restoration, Annual Performance Report, 1979-1980, Project F-9-12, 21 (SW-I-A), Juneau. [http://www.sf.adfg.state.ak.us/FedAidPDFs/f-9-12\(21\)SW-I-A.pdf](http://www.sf.adfg.state.ak.us/FedAidPDFs/f-9-12(21)SW-I-A.pdf)
- Mills, M. J. 1981a. Alaska statewide sport fish harvest studies - 1979 data. Alaska Department of Fish and Game, Federal Aid in Fish Restoration and Anadromous Fish Studies, Annual Performance Report 1980-1981, Project F-9-13, 22 (SW-I-A), Juneau. [http://www.sf.adfg.state.ak.us/FedAidPDFs/f-9-13\(22a\)SW-I-A.pdf](http://www.sf.adfg.state.ak.us/FedAidPDFs/f-9-13(22a)SW-I-A.pdf)

## REFERENCES CITED (Continued)

- Mills, M. J. 1981b. Alaska statewide sport fish harvest studies - 1980 data. Alaska Department of Fish and Game, Federal Aid in Fish Restoration and Anadromous Fish Studies, Annual Performance Report 1980-1981, Project F-9-13, 22 (SW-I-A), Juneau. [http://www.sf.adfg.state.ak.us/FedAidPDFs/f-9-13\(22b\)SW-I-A.pdf](http://www.sf.adfg.state.ak.us/FedAidPDFs/f-9-13(22b)SW-I-A.pdf)
- Mills, M. J. 1982. Alaska statewide sport fish harvest studies - 1981 data. Alaska Department of Fish and Game, Federal Aid in Fish Restoration and Anadromous Fish Studies, Annual Performance Report 1981-1982, Project F-9-14, 23 (SW-I-A), Juneau. [http://www.sf.adfg.state.ak.us/FedAidPDFs/f-9-14\(23\)SW-I-A.pdf](http://www.sf.adfg.state.ak.us/FedAidPDFs/f-9-14(23)SW-I-A.pdf)
- Mills, M. J. 1983. Alaska statewide sport fish harvest studies - 1982 data. Alaska Department of Fish and Game, Federal Aid in Fish Restoration and Anadromous Fish Studies, Annual Performance Report 1982-1983, Project F-9-15, 24 (SW-I-A), Juneau. [http://www.sf.adfg.state.ak.us/FedAidPDFs/f-9-15\(24\)SW-I-A.pdf](http://www.sf.adfg.state.ak.us/FedAidPDFs/f-9-15(24)SW-I-A.pdf)
- Mills, M. J. 1984. Alaska statewide sport fish harvest studies - 1983 data. Alaska Department of Fish and Game, Federal Aid in Fish Restoration and Anadromous Fish Studies, Annual Performance Report 1983-1984, Project F-9-16, 25 (SW-I-A), Juneau. [http://www.sf.adfg.state.ak.us/FedAidPDFs/f-9-16\(25\)SW-I-A.pdf](http://www.sf.adfg.state.ak.us/FedAidPDFs/f-9-16(25)SW-I-A.pdf)
- Mills, M. J. 1985. Alaska statewide sport fish harvest studies - 1984 data. Alaska Department of Fish and Game, Federal Aid in Fish Restoration and Anadromous Fish Studies, Annual Performance Report 1984-1985, Project F-9-17, 26 (SW-I-A), Juneau. [http://www.sf.adfg.state.ak.us/FedAidPDFs/f-9-17\(26\)SW-I-A.pdf](http://www.sf.adfg.state.ak.us/FedAidPDFs/f-9-17(26)SW-I-A.pdf)
- Mills, M. J. 1986. Alaska statewide sport fish harvest studies - 1985 data. Alaska Department of Fish and Game, Federal Aid in Fish Restoration and Anadromous Fish Studies, Annual Performance Report 1985-1986, Project F-10-1, 27 (RT-2), Juneau. [http://www.sf.adfg.state.ak.us/FedAidPDFs/f-10-1\(27\)RT-2.pdf](http://www.sf.adfg.state.ak.us/FedAidPDFs/f-10-1(27)RT-2.pdf)
- Mills, M. J. 1987. Alaska statewide sport fisheries harvest report, 1986. Alaska Department of Fish and Game, Fishery Data Series No. 2, Juneau. <http://www.sf.adfg.state.ak.us/FedAidPDFs/fds-002.pdf>
- Mills, M. J. 1988. Alaska statewide sport fisheries harvest report, 1987. Alaska Department of Fish and Game, Fishery Data Series No. 52, Juneau. <http://www.sf.adfg.state.ak.us/FedAidPDFs/fds-052.pdf>
- Mills, M. J. 1989. Alaska statewide sport fisheries harvest report, 1988. Alaska Department of Fish and Game, Fishery Data Series No. 122, Juneau. <http://www.sf.adfg.state.ak.us/FedAidPDFs/fds-122.pdf>
- Mills, M. J. 1990. Harvest and participation in Alaska sport fisheries during 1989. Alaska Department of Fish and Game, Fishery Data Series No. 90-44, Anchorage. <http://www.sf.adfg.state.ak.us/FedAidPDFs/fds90-44.pdf>
- Mills, M. J. 1991. Harvest, catch, and participation in Alaska sport fisheries during 1990. Alaska Department of Fish and Game, Fishery Data Series No. 91-58, Anchorage. <http://www.sf.adfg.state.ak.us/FedAidPDFs/fds91-58.pdf>
- Mills, M. J. 1992. Harvest, catch, and participation in Alaska sport fisheries during 1991. Alaska Department of Fish and Game, Fishery Data Series No. 92-40, Anchorage. <http://www.sf.adfg.state.ak.us/FedAidPDFs/fds92-40.pdf>
- Mills, M. J. 1993. Harvest, catch, and participation in Alaska sport fisheries during 1992. Alaska Department of Fish and Game, Fishery Data Series No. 93-42, Anchorage. <http://www.sf.adfg.state.ak.us/FedAidPDFs/fds93-42.pdf>
- Mills, M. J. 1994. Harvest, catch, and participation in Alaska sport fisheries during 1993. Alaska Department of Fish and Game, Fishery Data Series No. 94-28, Anchorage. <http://www.sf.adfg.state.ak.us/FedAidPDFs/fds94-28.pdf>
- Szarzi, N. J., and R. N. Begich. 2004. Recreational fisheries in the Lower Cook Inlet Management Area, 1995-2000. Alaska Department of Fish and Game, Fishery Management Report No. 04-06, Anchorage. <http://www.sf.adfg.state.ak.us/FedAidPDFs/fmr04-06.pdf>
- Szarzi, N. J., R. N. Begich, S. C. Meyer, and S. W. Albert. *in prep.* Recreational fisheries in the Lower Cook Inlet management area, 2001-2004. Alaska Department of Fish and Game, Fishery Data Series, Anchorage.

## **REFERENCES CITED (Continued)**

Walker, R. J., C. Olnes, K. Sundet, A. L. Howe, and A. E. Bingham. 2003. Participation, catch, and harvest in Alaska sport fisheries during 2000. Alaska Department of Fish and Game, Fishery Data Series No. 03-05, Anchorage. <http://www.sf.adfg.state.ak.us/FedAidPDFs/fds03-05.pdf>